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Fish & Wildlife Division

RESOURCE STATUS AND ASSESSMENT BRANCH

Alberta Species at Risk Report No. 40

Alberta
SUSTAINABLE RESOURCE DEVELOPMENT

Management and Recovery Strategies for the Lethbridge Population of the Prairie Rattlesnake

Reg Ernst

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Executive Summary

The coulees of southwest Lethbridge are home to a population of prairie rattlesnakes (*Crotalus viridis viridus*). Population estimates based on observational monitoring at known hibernacula indicate that the population is very small, estimated to be 30 - 40 adults. High rates of mortality from road kills, deliberate human persecution, and a rapid loss of habitat from subdivision and recreational development make the future of Lethbridge rattlesnakes uncertain.

In the fall of 1999, concerned citizens and staff from the City of Lethbridge determined that a management plan was necessary if the Lethbridge population of rattlesnakes was to be saved from elimination. In 2000, a committee was formed to develop a management plan. Public participation was solicited through an open house and public attitude towards maintaining a Lethbridge population of rattlesnakes was evaluated using a questionnaire. The more than 70 residents attending the open house and answering the questionnaire expressed a strong desire to conserve and enhance the remaining population of prairie rattlesnakes through recovery efforts. As well, a strong focus on public education and cooperation between interested groups was initiated in 2000 and continued in 2001.

This report integrates previous work done in Lethbridge, includes pertinent actions from the draft management plan developed in 2000 and summarizes and discusses present and future recovery efforts. The main difference between recovery efforts initiated in 2001 and the 2000 management plan is the shift in focus from efforts to maintain the population of rattlesnakes in Popson Park to establishing a new population in Cottonwood Park where their long-term survival seems more likely. The shift in focus was considered necessary because the Popson Park/Paradise Canyon area does not provide a secure location for a hibernaculum nor does it provide secure rattlesnake habitat. Cottonwood Park offers many advantages including its location away from residential and recreational areas, its designation as a Nature Reserve, its lack of road access and its favorable habitat features.

During May of 2001, a hibernaculum was constructed in Cottonwood Park complete with holding area to contain captured rattlesnakes. Individual rattlesnakes that were in conflict with humans (e.g.: unwanted snakes in yards, on busy roads, in subdivisions, or rattlesnakes adjacent to these high-risk areas) were captured and relocated to the hibernaculum throughout the summer. A feeding program was initiated at the hibernaculum and snake behavior was monitored during numerous visits over the summer and fall of 2001.

In 2001, a strong emphasis on education and cooperation resulted in many reports of snake activity and calls for relocating rattlesnakes. This is in contrast to previous years when reports of rattlesnake activity were lacking and the fate of rattlesnakes in conflict with humans was uncertain. Continued efforts to provide public education and the participation and cooperation of all interested groups and citizens will be necessary to recover and maintain a sustainable rattlesnake population in Lethbridge.

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1.0 Introduction

The natural areas of southwest Lethbridge are home to a small population of prairie rattlesnakes. Human developments and activities have reduced available habitat and have resulted in barriers to normal migration routes used by rattlesnakes going to and from their summer feeding areas. Road kills on the Paradise Canyon access road, human/snake conflicts within recreation areas and subdivisions, and deliberate killings by humans may be reducing the population below sustainable levels.

In 1997, a rattlesnake study was initiated by the City of Lethbridge to search for hibernacula (denning areas), estimate population numbers and demographics, and determine movement patterns. This study was observational in nature; there were no electronic tracking devices implanted nor any other treatments applied requiring the capture of rattlesnakes. The study was continued for the 1998 and 1999 seasons.

Following three years of observations at known rattlesnake denning sites in Lethbridge, the need for a management plan was identified. In 2000, interested groups and jurisdictions, including Alberta Fish and Wildlife Division, Lethbridge Naturalists Society, City of Lethbridge, and Alberta Conservation Association, were contacted and requested to participate in the development of a management plan. Prior to writing the management plan, a questionnaire was distributed during an open house to determine if Lethbridge residents would support recovery efforts. Of the respondents, more than 90% indicated a strong desire to maintain the Lethbridge population of rattlesnakes.

In 2000, a draft management plan was developed which focused on public education and improving rattlesnake habitat in Popson Park. That plan included a strategy to improve habitat and maintain a population in Popson Park. This strategy was modified somewhat in 2001 due to recent high mortality rates in the Paradise Canyon and Popson Park areas, and the revelation that the City of Lethbridge will further develop Popson Park. The realization that a sustainable population for rattlesnakes in Lethbridge likely cannot be achieved at the Popson Park site alone, has led to amendment of the management plan (see Appendix 2) to increase emphasis on establishment of a more secure hibernaculum. Many of the 2001 project activities concentrated on this initiative.

2.0 Recovery Plan Goal and Objectives

2.1 Goal

The goal of the Lethbridge Rattlesnake Recovery Plan is to recover the Lethbridge population of the prairie rattlesnake to a sustainable level.

2.2 Objectives

There are several specific objectives:

1. To provide public education regarding rattlesnakes, focussing on their importance, conservation and safety precautions.
2. To reduce human/snake conflicts in subdivisions and recreational areas.

3. To provide secure hibernacula and foraging areas for rattlesnakes in Lethbridge by relocating problem rattlesnakes from the Popson Park population to Cottonwood Park over the next three years.
4. To reduce killings of rattlesnakes by humans.
5. To stimulate research to improve understanding of rattlesnake movement, numbers, and population dynamics in Lethbridge.

3.0 Biology and Behavior of Prairie Rattlesnakes

3.1 Taxonomy

The western rattlesnake (*Crotalus viridis*) is a member of the subfamily Crotalinae, family Viperidae, and is one of the many species of North American pit vipers. In southeastern Alberta and southwestern Saskatchewan, the subspecies present is *Crotalus viridus viridis,* which is commonly referred to as the prairie rattlesnake.

3.2 Morphology

Adult prairie rattlesnakes normally range from 60 to 150 centimeters in length. Duvall et al. (1985) found that rattlesnakes from a studied population in Wyoming ranged in length to 125 cm and averaged 90 cm and 79 cm for males and females respectively. A 100 cm long rattlesnake would weigh about 0.5 kilogram.

Rattlesnakes have a broad triangular shaped head with a deep pit on each side of the face between the eye and snout. Their basic color is brown, tan, olive or grey overlain with large dark-brown blotches along the back and smaller blotches along the sides. They have a broad, dark stripe on each side of their face. The under side of the body is usually yellowish-white. Juveniles are usually somewhat lighter in color than adults. Newly born rattlesnakes are about 20-25 cm long with a dark button on the tip of their tail in place of a rattle.

Rattlesnakes lack external ear openings so they cannot hear in the traditional sense but are sensitive to air and ground vibrations. Their sense of smell comes from two sources: external nostrils lined with olfactory cells and a forked tongue, which is their primary sensory organ for smelling. A snake's skeleton consists of a skull and jaws, a backbone, and ribs.

3.3 Biology

As snakes feed and grow they must grow new skins, shedding their old ones to compensate for their increased body size. Each time they shed, they grow a new segment for their rattle apparatus. Rattle segments indicate the number of skin sheddings rather than age because each time the skin is shed, a new rattle segment is grown. The number of rattle segments may not be a good indicator of age or the number of sheddings they have undergone because rattle segments have a tendency to break off when the rattler apparatus gets too long (Klauber 1972). Gannon and Secoy (1985) found that rattlesnakes in general shed twice a year, faster growing individuals may shed three times a year while gravid females shed only once a year.

Being ectothermic (unable to self-regulate body temperature), rattlesnakes do not have the same energy demands as warm-blooded species. Therefore, energy is required only for growth and

reproduction and since prairie rattlesnakes hibernate from October through April, their energy requirement on an annual basis is relatively low. The summer foraging season is short and cooler days may render them immobile and therefore incapable of hunting. This makes the ability to successfully navigate to and from suitable foraging areas crucial to their survival.

3.4 Diet and Feeding

Snakes occupy small mammal burrows and ambush prey as the prey enters the burrow (Duvall et al. 1985). Rattlesnakes locate their prey visually as well as by using infrared heat-sensing organs (loreal pits) located on each side of their face. Prey for rattlesnakes includes ground squirrels, deer mice, lizards, birds, and insects.

They usually strike their victim with a forward stabbing motion, injecting venom through hollow fangs. After injecting the venom, they withdraw and let the victim die. Then they follow the scent trail left by the victim and once it is located they devour the now dead prey headfirst. The venom causes muscular paralysis by blocking nerve conduction and it contains an enzyme to digest tissue. Snakes are not physically capable of portioning food into smaller pieces so they must swallow their prey whole; however, they are able to drop their bottom jaw out of its sockets allowing them to envelop prey far larger than their normal mouth opening could accommodate (Askham and Duffy, 1993). This enables them to swallow prey such as rodents and other small mammals.

3.5 Reproductive Ecology

Gannon and Secoy (1985) suggest that female rattlesnakes may have a biennial or greater reproductive cycle, meaning that at most, they produce offspring every second year. Most studies indicate that breeding takes place in the spring and early summer, but in Wyoming, Duvall et al. (1985) observed all breeding activity taking place from late July to the first week in September. Northern populations are likely late summer - fall breeders. Whether the female is successful in completing the reproductive cycle may depend on available fat stores (Graves and Duvall, 1993) that are carried over from the previous year. Pregnant female rattlesnakes may not feed the year they give birth. Pregnant females emerge from hibernation in April and migrate to a nearby birthing area where they remain with other pregnant females until they give birth to 4-12 young in late summer. Larger female snakes are more productive than smaller ones (Graves and Duvall 1993).

Thermoregulation is thought to be an important factor in the successful reproduction of prairie rattlesnakes (Graves and Duvall 1993). Disturbing pregnant rattlesnakes (i.e. driving them underground) would likely have an adverse effect on successful reproduction.

Graves and Duvall (1993) suggest that birthing areas are used in consecutive years by different females and are selected based on their thermoregulatory properties as well as their ability to provide secure birthing habitat. They found that body temperatures of pregnant snakes were higher than that of other snakes and time spent basking in the sun was greatest when air temperatures were in the $15\text{-}25^0$ C range. Below optimum temperatures may be one of the most limiting factors to successful reproduction (Graves and Duvall 1993). Female snakes do not provide any parental care although neonates (baby snakes) remain in the rookery area until they migrate to the hibernaculum in September. Young snakes may feed on such prey as grasshoppers

prior to denning but Charland (1989) suggested (from his review of the literature) that young reptiles might live off their post-hatching yolk for up to several months after birth.

Duvall et al. (1985) suggest that neonates remain in aggregates until about 10 days after birth. They then shed their "baby" skins and behave as individuals. Young snakes are thought to migrate separately from adults to their hibernaculum, navigating with the aid of scent trails left by adult snakes. The main hibernaculum in Lethbridge consists of a series of holes along the rim of a steep southeast-facing slope. At this site, rattlesnakes use various holes within the hibernaculum area to give birth rather than migrating to some other location as the literature indicates other populations do.

Two birthing areas, sometimes called rookeries or creches (Beaupre and Duvall 1998) were first discovered during the third week of August, 1998 in Popson Park. Two large and two medium sized snakes were observed near the birthing area on August 18. On August 26 there were two separate clutches of young (6-8 per clutch) observed occupying two separate holes at this site. Presumably, they were born sometime between August 18 and August 26. By September 2, the neonates were no longer visible at the birthing areas even though the weather was sunny and warm. It is not known whether they remained underground for some reason or whether they had already migrated to the nearby hibernaculum.

One clutch seemed to have larger young than the other one but observations are difficult without disturbing the young snakes. The other birthing area was discovered on August 22 about 100 m south of the slope hibernaculum in Popson Park on a fairly steep east-facing slope. One clutch of 6-8 neonates was found at this site. Their hole was located under the canopy of a robust clump of plains muhly grass. At the time the birthing areas were first discovered, there were adult snakes present but during subsequent visits only the young were observed. Perhaps the mature snakes abandon the neonates to avoid drawing attention to them.

During the summer of 2001, one or more of the captive rattlesnakes at Cottonwood Park gave birth. A clutch of about 10 neonates was first observed there on August 30 (Photo 1). As well, two clutches of neonates were observed during the same period at the Popson Park main hibernaculum.

3.6 Thermal Requirements and Overwintering Survivorship

As ectotherms, snakes are vulnerable to ambient temperatures falling outside of their functional range. Snakes aggregate to compensate for a drop in temperature (Gannon and Secoy, 1985). By forming a ball, the surface area to mass (ratio) is reduced thus retarding the cooling effect and perhaps water loss. Optimum body temperature for rattlesnakes is likely in the 20-30^0 C range, but Duvall et al. (1985) reported breeding activity at air temperatures as low as 13.4^0 C. Other studies have reported critical maximum temperatures of 38^0 C, making summer shade an important habitat feature.

Rattlesnakes require winter denning areas that are frost-free and summer habitat features with temperatures within their functioning range estimated to be in the 15^0 C - 30^0 C range. Coulee slumping and underground piping channels may be important phenomena in providing suitable winter denning sites. MaCartney et al. (1989) found that overwintering temperatures inside a den

located in the Okanagan Valley of British Columbia varied between 3 and 5^0 C during the coldest part of the winter and were affected very little by external fluctuations in temperature. Snakes would move around within the hibernaculum to take advantage of heat gradients.

Charland (1989), during his study of western rattlesnakes in the Okanagan Valley of British Columbia and through his review of the literature, found that survivorship among neonates was 55 to 76%. As well, he found no evidence that neonates feed prior to hibernation but he did find that five neonates captured as yearlings after their first summer of foraging ranged in weight from a 20% loss at birth to a gain of over 100%. Parker and Brown (1974) in their study of rattlesnakes in Northern Utah, found that over-wintering mortality of rattlesnakes in general was only 3.6% compared to summer mortality rates of 17.8%. Some studies have indicated winter survivorship of neonates may be 0%; other studies indicate high survivorship. Winter survivorship is likely highly dependent on hibernaculum features as well as yearly variations in weather. Mature snakes in good condition may tolerate lower temperatures than neonates or adult snakes in poor condition.

3.7 Spring Emergence

It is likely that snakes emerge above ground when there is a thermal advantage to it, particularly in early spring. MaCartney et al. (1989) found that snakes did not emerge on a daily basis until temperatures inside the den reached 11^0 C and external weather was precipitation free with temperatures above 15^0 C. In Lethbridge, rattlesnakes start emerging during the first week of April depending on weather conditions. Observations at the Popson Park hibernacula indicate that snakes emerged during sunny weather when temperatures were greater than about 13^0 C.

Solar radiation may be more important than ambient temperature to determine if snakes will emerge from their hibernaculum (i.e. microclimatic features are very important). They will emerge when the air temperature is less than 15^0 C where basking temperatures in sunny protected areas are likely several degrees higher. Wind is not a major factor because snakes generally bask in shallow holes well protected from the wind and directionally aligned so they can take maximum advantage from the sun's rays. Generally, when the weather was warm enough for high levels of grasshopper activity, the snakes were out of their hibernacula.

In April 1998 intensive monitoring was carried out at the rim hibernaculum in Popson Park. The first snake was observed above the surface on April 3. By April 21st, the snakes had departed from their normal routine of simply basking in the sun and begun to move around the hibernaculum area. By April 23 rd the snakes had started to leave the hibernaculum area and by April 29 th there were only a few left. These may have been pregnant females remaining behind to give birth.

The first snake observed away from the hiberncula in 1998 was on April 23 rd. It was found in the vicinity of a burrow about 200 m south of the rim hibernaculum. On April 29 th two snakes were encountered several hundred meters north of the Popson Park rim hibernaculum traveling north, presumably heading for summer foraging areas. These observations indicate dispersal along at least two quadrants (north and south) from the rim hibernaculum.

Similar dispersal dates were observed for the slope hibernaculum at Popson Park, but direction of movement was not detected. Later observations suggested that direction of dispersal was in all directions except west. At another site in West Lethbridge, known as the Bickman hibernaculum, snakes remained until about mid-June; but direction of dispersal was not observed.

3.8 Migration

After emerging from hibernation and spending several days in the vicinity of the hibernaculum, rattlesnakes migrate in a straight line (perhaps using the sun to navigate) until they encounter suitable foraging sites where they hunt and ambush prey (Duvall et al. 1985). Foraging sites may be several hundreds of meters from hibernacula.

Duvall et al. (1985) in their study of a Wyoming population of prairie rattlesnakes found that the average distance traveled to foraging areas was 5640 meters. Some rattlesnakes have been reported to travel as much as 20 miles (44 km) from their hibernaculum (Klauber, 1972), but Parker and Brown (1974) in their study found the maximum distance traveled by any snake was 1040 meters. Powell et al. (1998) found that some rattlesnakes in southern Alberta traveled up to 12 km from their hibernaculum during the summer foraging season. Towards autumn and as daytime temperatures cool, rattlesnakes navigate back to the vicinity of their hibernaculum where they remain until actual hibernation begins in late October. Navigation may be by using scent trails, the sun, or perhaps by using a combination of the two.

3.9 Defensive Behavior

Examples of defensive behavior include protective coloration, actions such as coiling and rattling, and actual strikes and bites (Klauber 1972). Snakes are well camouflaged and are very difficult to see when in their natural habitat. When snakes feel threatened they may lie motionless, relying on their coloration to avoid detection. Duvall et al. (1985) found that defensive behavior consisted first of procrypsis (lying motionless), secondly attempting to escape, and if that failed then more active type defense strategies such as coiling, cocking and rattling, and if sufficiently provoked, striking. Occasionally defensive bites may be dry (no venom injected). Generally, physical contact is necessary to elicit a strike.

Duvall et al. (1985) during their study of a population in Wyoming found that snakes near cover and hibernacula responded more aggressively to their presence than did snakes encountered on open prairie. They also observed that free-ranging prairie rattlesnakes struck only about 2% of the time even when they were threatened vigorously and continuously. However, when actually touched, they struck about 39% of the time.

Local observations indicate defensive behavior varies considerably between individuals. Some snakes seem to be less alert or less agitated by outside stimuli than others. Some snakes may advance towards a human when they became aware of their presence. The reason for this behavior is not known, but may be based more on curiosity rather than aggression. The snakes at the Bickman property in West Lethbridge seemed to be more sensitive to human presence than those at Popson Park, possibly because they had experienced higher levels of disturbance.

Unless snakes are actually traveling, they are usually close to a hole where they will readily escape if disturbed. Observations indicated that snakes caught in the open will typically go into a

defensive pose, rattle very loudly, sometimes hiss and stand their ground. Snakes near cover (burrows) will usually rattle and then quickly disappear into the burrow. Close encounters with rattlesnakes in Lethbridge indicate that rattlesnakes are very reluctant to strike and probably would only do so if physical contact were made.

3.10 Snake Bites

Rattlesnakes are venomous members of the pit viper family. The venom of the prairie rattlesnake is a hemotoxin that affects the blood and lymphatic system and causes pain and rapid swelling in the victim. Rattlesnakes are rarely aggressive and will avoid human contact when they can. Most snake bites are not lethal. There has only been one death attributed to a rattlesnake bite in Canada in the last ten years (Palliser Health Authority, personal communication). The snake was an eastern species, not a prairie rattlesnake and apparently, the victim did not seek medical attention. Snakebites to humans are rare in Lethbridge but bites to dogs are more common. Interviews with local veterinarians revealed that in most years one or more dogs are bitten in the City. There have been no known dog fatalities from rattlesnake bites in Lethbridge. Dogs are not given antivenin but instead are treated with antibiotics and cortisone and usually recover after several days of treatment. During the summer of 2000, a rattlesnake reportedly bit a golfer in Lethbridge. Apparently, he was unaware he had been bitten until sometime later when his lower leg swelled and he visited the hospital for treatment.

4.0 Distribution and Status of the Prairie Rattlesnake

4.1 Distribution

Climate, suitable denning sites, and land use are probably the three most important factors in determining rattlesnake distribution (Pendlebury, 1977). The western rattlesnake or its subspecies can be found from southern Canada through the central United States to as far south as Mexico (Figure 1). In Alberta, rattlesnake distribution is limited to the mixed-grass prairie biome, the warmest and driest region in the province (Figure 2).

4.2 Status

The Alberta government's recent status report (Watson and Russell, 1997) states that there is considerable cause for concern as populations of rattlesnakes may be declining across most of their Alberta range. Intentional persecution, roads and pipeline construction, and agricultural activities are all cited as reasons why rattlesnake numbers may be in decline in Alberta.

Figure 1. North American distribution of the western rattlesnake. The dark region represents the distribution of the prairie subspecies (From Watson and Russell 1997).

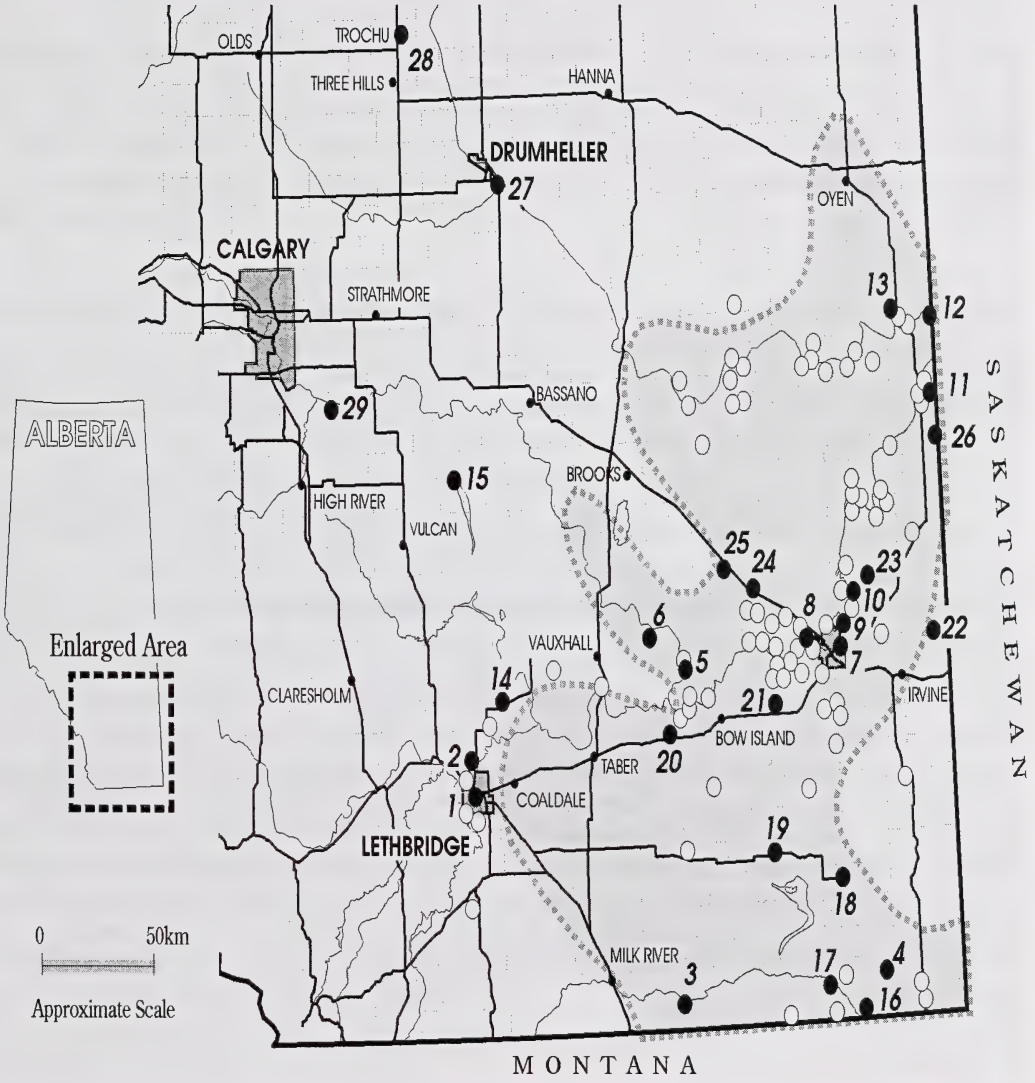

Figure 2. Distribution of the Prairie Rattlesnake in Alberta. Open circles represent recent records and solid circles represent pre-1978 records. (From Watson and Russell, 1997).

Rattlesnakes are protected under the Alberta Wildlife Act. It is illegal to kill, possess, buy or sell rattlesnakes or harm their hibernacula. Nevertheless, human persecution is still considered a major factor in the decline of rattlesnake numbers across much its range.

Lethbridge is located within the mixed grass prairie region and is home to a small population of the prairie rattlesnake. Exact numbers are not known but observations at known hibernacula over the past five years indicate the Lethbridge population of prairie rattlesnakes is very small, perhaps as few as 30 – 40 adults. Many kilometers of foot travel (by City of Lethbridge staff) through the natural areas in Lethbridge during the summers of 1997 and 1998 revealed rattlesnakes at only five different sites (other than the hibernacula). Most rattlesnake observations occur in Popson Park or adjacent subdivisions.

None of the literature reviewed gave estimates of what constitutes a minimum viable population for rattlesnakes, but Parker and Brown (1974) expressed doubts about the survival of a population of rattlesnakes in Northern Utah that numbered 12-17 individuals. They concluded that rattlesnake populations may take centuries to recover because of their late maturity, because of their aggregation at specific areas during denning leaves them vulnerable to spring and autumn losses, and because their rattling attracts attention making them vulnerable to man-caused mortality. The locating and maintenance of rattlesnake hibernacula in the areas surrounding the City may be a very important consideration in sustaining a long-term population in Lethbridge.

5.0 Threats to the Lethbridge Prairie Rattlesnake Population

5.1 Urbanization and Recreational Development

Habitat loss through urbanization and recreational development is the biggest threat facing rattlesnake populations in Lethbridge. During 1997 and 1999 two coulees adjacent to Paradise Canyon received major renovations using heavy equipment. Any suitable habitat or hibernacula (if any existed) in the coulees would have been destroyed. New residential development is occurring north and northwest of Popson Park, blocking seasonal migration routes of rattlesnakes and removing their historical habitat. The Paradise Canyon subdivision continues to grow (Photo 2, Appendix 4), the Riverstone subdivision is now being developed and further subdivisions are being planned on what is important habitat for the Popson Park rattlesnake population. Subdivision and recreational development are now within one kilometer of the Popson Park hibernaculum.

5.2 Road Kills

Actual losses from road-kills are difficult to document, but reports suggest that at least eight rattlesnakes are road- killed each year. In 2001, reports indicate there were five rattlesnake fatalities on the Paradise Canyon Road, two on Bridge Drive, and one in a parking lot in West Lethbridge. These numbers are based on reports only, actual rattlesnake mortality may be considerably higher. In recent years, many rattlesnakes have died on the Paradise Canyon road (Photo 3, Appendix 4), which presents a barrier to normal migration patterns. Witnesses have reported deliberate road kills. As the subdivision grows and the recreational facilities associated with it become more popular, traffic on the access road will continue to increase resulting in more rattlesnake deaths.

5.3 Deliberate Human Caused Mortality

Subdivisions, golf courses, and other recreational areas create human/snake conflicts. In 2000, reports indicated that as many as ten rattlesnakes may have been killed, some accidentally and some deliberately. In 2001 there were at least four deliberate human-caused mortalities, and there may have been unreported deaths as well. In1997, an unknown number of rattlesnakes were killed by a sports club operating on private land (the Bickman Property). Apparently, this group was not aware it was illegal to kill rattlesnakes in Alberta. Rattlesnakes frequent the area around the boat launch site and the picnic shelter at Popson Park making them vulnerable to deliberate killing at those sites.

The fate of rattlesnakes entering subdivisions depends on the person discovering them. Some people have taken matters into their own hands and killed snakes or removed them to a location where survival is unlikely. The hibernaculum in Popson Park is vulnerable to human disturbance because its location is becoming well known and because of increased human activity in the park. Disturbance, even without intent to harm, places undue stress on individual snakes, particularly pregnant females.

5.4 Increased Recreational Conflicts

Popson Park is managed to provide recreational opportunities for people while allowing for natural processes to continue. Because the park is accessible by road, it receives considerable use and use is expected to increase as more of the park is developed. Conflicts between people and rattlesnakes occur at the park. An off-leash dog run established in Popson Park in the spring of 2001 will increase the potential for human/snake conflicts. Over the past few years, rattlesnakes in Popson Park have bitten several dogs, including at least one in 2001.

The only known ground squirrel (*Spermophilus richardsonii*) colony in Popson Park is located around the picnic shelter. The ground squirrels are important prey for rattlesnakes. This is another conflict point between park users and rattlesnakes. A grass fire in December of 2000 has provided potential habitat for ground squirrels in the northern portion of the park by removing the tall vegetation; however, it is not known if other habitat features are suitable for ground squirrel colonies on the burned area. Lack of suitable foraging areas (i.e. ground squirrel colonies) and conflict points with people are likely limiting factors in providing secure and productive habitat for rattlesnakes in Popson Park.

5.5 Natural Predation

Within the river valley there are wildlife species that prey on rattlesnakes. It is known that badgers, coyotes, and raptors prey on rattlesnakes; but it is not known how much natural predation occurs on the Lethbridge population. Klauber (1972) states that deer will also kill rattlesnakes; natural areas in Lethbridge are home to an estimated 400 - 500 deer. It is not known what impact predators have on the local population of rattlesnakes, but it is unlikely that predation would have a significant impact on a healthy population of rattlesnakes.

5.6 Coulee Slumping

Coulee slumping may also destroy hibernacula. A visit during the spring of 1997 to a site that had been occupied by snakes during the summer of 1996 revealed that slumping had buried the

entrance. It is not known how many snakes, if any, were destroyed or if the slumping was a natural process or caused by agricultural (i.e. irrigation) activities on the fields above.

6.0 Management Actions

6.1 Response to Rattlesnake Occurrences

For many years, Alberta Fish and Wildlife Conservation Officers removed problem rattlesnakes from within the city and relocated them to areas outside the city. The survival rate of displaced snakes is not known but is thought to be very low. Studies indicate that rattlesnakes navigate away from fixed points in a straight line using the sun as a guide, therefore, it is unlikely that displaced rattlesnakes would be able to relocate their hibernaculum. Recognizing this fact, Fish and Wildlife Conservation Officers have been moving snakes to the Popson Park area since 1995. It is thought that scent trails in Popson Park will lead displaced snakes to the hibernaculum although there has been no research to support this assumption.

In 2001 procedures were developed for the capture and removal of problem rattlesnakes from the Paradise Canyon golf course and adjacent subdivisions. Coordination was done through Alberta Fish and Wildlife, with involvement from the City of Lethbridge and the Paradise Canyon Land Corporation. A snake-handling workshop was held to provide guidance on proper snake handling techniques. Information on reporting protocol and contact numbers was widely distributed throughout the subdivisions, acreages, and parks of southwest Lethbridge. Extensive communication continues with all groups affected by this project.

To reduce human/snake conflicts and to improve public safety, in 2001 rattlesnakes were captured and relocated whenever they were considered either as problem or "vulnerable" (see categorization below). The Paradise Canyon Golf Club was provided a set of tongs for capturing problem rattlesnakes and the snake-handling workshop provided them with the necessary training. A number of people including Conservation Officers and trained volunteers were available to respond to calls for rattlesnake removals. Efforts were made to mark captured rattlesnake by spray-painting their rattle section with livestock paint, but not all snakes were successfully marked due to handling difficulties when only one person was available to respond.

For the purposes of this management plan, rattlesnake activity is categorized as follows:

Problem: Rattlesnakes reported in subdivisions or in recreation areas where conflict with people is imminent. Conservation officers are called to capture and relocate problem snakes to the Cottonwood Park hibernaculum. When Conservation Officers are not immediately available, trained volunteers are contacted.

Vulnerable: Rattlesnakes that are observed in areas where they are likely to come in conflict with people or are at risk of being harmed (e.g. a rattlesnake along the edge of the Paradise Canyon Road). Normally, project staff or trained volunteers capture and relocate these rattlesnakes to the Cottonwood Park hibernaculum.

Routine reports: Reports of rattlesnake activity in the coulee areas of Lethbridge where risk of harm to the rattlesnake is minimal and conflict with people is unlikely (e.g. reports of a

rattlesnake sighting in Cottonwood Park or rattlesnakes using the natural areas in Popson Park. No action is taken on routine reports.

In 2001, 30 calls were received for the removal of problem or "vulnerable" rattlesnakes. Twenty-two resulted in removal; in the other 8 cases the snakes were not found. As well, 8 calls were received to report rattlesnake mortality and another 17 "routine" calls were received. Most of the calls for rattlesnake removal came from the Paradise Canyon area while most reports of rattlesnake activity came from the floodplain in Popson Park. Appendix 3 contains a summary of 2001 rattlesnake reports and removals.

6.2 Education

Public education is important to recovery efforts and will be an ongoing element of the management plan. Understanding and cooperation from affected groups and jurisdictions is a necessary prerequisite for implementing the management actions outlined in this plan. Ongoing education initiatives are necessary for the long-term survival of a prairie rattlesnake population in Lethbridge.

The brochure "Rattlers, People and Parks: The Prairie Rattlesnake in Lethbridge" was distributed through the Lethbridge Public Library and the Helen Schuler Coulee Center, hand delivered to homes in the Riverstone and Mountain Heights subdivisions and provided to recreational operators in the vicinity of the Bickman property. The brochures were distributed to the residents of Paradise Canyon through their newsletter published in May of 2001. Brochure stations were installed in Popson and Cottonwood Parks. The City of Lethbridge summer park ranger also distributed brochures and other information to park users in southwest Lethbridge.

A rattlesnake display was established and set up at the Helen Schuler Coulee Centre. This display was also erected at the Coulee Cactus Crawl, a trail-running race sponsored by Runner's Soul. Several media interviews and programs were completed in 2001 to educate the public about the Lethbridge population of rattlesnakes. These included: interviews on CBC and CJCA radio; newspaper articles in the Lethbridge Herald, Calgary Herald, and Edmonton Journal; a TV interview on global television, and a program on Discovery channel.

During the summer of 2001, about 50 reports were received from the public of rattlesnake activity. This is a sharp increase over previous years and is likely a result of recent education efforts.

6.3 Inventory

In fall of 1997 the Popson Park "Rim hibernaculum was discovered. An estimated 14 adult rattlesnakes were observed at that time. Two additional hibernacula were discovered in 1998; one more in Popson Park, the "slope" hibernaculum and one on the Bickman property (across from the Par 3 golf course). In 1998 10 adults were observed at the slope hibernaculum and 5 adults at the Bickman hibernaculum.

Estimating rattlesnake populations based on visual observations may be subject to gross errors. Rattlesnakes are hard to count when there are a number of them intertwined and when avoiding

disturbing them is important. Also, some snakes may be missed because they may remain concealed under vegetative cover or because they remain underground.

The Lethbridge population of rattlesnakes based on hibernacula observations during the spring of 1998 was estimated at a minimum of 29 adults. This figure was arrived at by adding the maximum number of rattlesnakes seen at each of the three known hibernacula (14 at Popson Park rim, 10 at Popson Park slope and 5 at Bickman). In addition to this figure there were three clutches of neonates (15-20 total) observed during late August 1998. Observations in 2000 suggested that the population may have been substantially lower than it was in 1998, while the census in 2001 revealed 23 at the rim hibernaculum, 2 at the Bickman property and none at the lower hibernaculum in Popson Park.

In 2001, 23 rattlesnakes were counted at the Popson Park Rim hibernaculum of which about 10 were considered mature adults, another 10 were considered to be juveniles or young adults and three were the previous years neonates. None were observed at the slope hibernaculum. The increase in numbers at the rim hibernaculum may be accounted for by increased visibility due to a burn in December 2000 that removed all of the vegetative cover in the hibernaculum area.

During the spring of 2001, a search of the river valley in southwest Lethbridge was done in an attempt to locate additional hibernacula. As well, a search was done during the spring and fall of 2001 along the river valley adjacent to Lethbridge to search for hibernacula. In the latter case, inquiries were made based on previous reports of rattlesnake activity. Landowners were contacted for any information they might have related to rattlesnake activity and to gain access to their land to do the search. The search area extended from the river valley north of Coaldale upstream to the southern portion of the Blood Reserve.

No new hibernacula were found in Lethbridge, but several sites which may provide hibernacula were located along the river valley adjacent to Lethbridge. One site located across the river from Cottonwood Park is known to have been an active hibernaculum in the past and sightings in and around the hibernaculum in 2001 indicate it may still be active. Reports of two sites on the Blood Reserve were investigated, with rattlesnake activity observed at both locations indicating possible hibernacula. Several locations were searched north of Lethbridge that resulted in the location of two possible hibernacula. All of the rattlesnake activity was witnessed in early spring and in the fall when the hibernacula would normally be occupied.

It is difficult to be certain that all of the sites found are hibernacula because rattlesnake activity was so limited. It seems unlikely that hibernacula with large populations still exist in the Lethbridge area. Deliberate human persecution and intensive agricultural activities have likely reduced the area population to scattered locations occupied by a few individual snakes. Reports from landowners indicate a strong historical (and in some cases, current) intolerance towards rattlesnakes.

6.4 Habitat Development – Construction of A New Hibernaculum

6.4.1 Rationale

Several considerations led to a decision to focus recovery efforts on establishing a population of rattlesnakes in Cottonwood Park by creation of a new, more secure hibernaculum there. These factors included current and planned development in Popson Park (e.g. establishment of an off-leash dog run in 2001), high mortality rates in the Popson Park and Paradise Canyon areas, lack of secure foraging habitat, and the vulnerability of the natural hibernaculum. Cottonwood Park has several advantages including:

- Protection as a Nature Reserve
- No road access
- No dogs allowed
- Different kind of park user because of rugged topography
- No nearby subdivisions-development will be limited because of terrain characteristics
- Ample suitable habitat including a large resident ground squirrel population

Only problem and "vulnerable" rattlesnakes were targeted for capture and relocation. By containing captured rattlesnakes at a suitable facility in Cottonwood Park and by forcing the rattlesnakes to spend at least one winter in their artificial winter den, it is hoped that they will bond to the site and return in subsequent years. As well, it is theorized that any neonates born at the Cottonwood Park site will recognize it as their home and return for hibernation. All rattlesnakes captured during 2001 will be released from the hibernaculum in the spring of 2002, allowing testing of these assumptions during the fall migration of 2002.

6.4.2 Construction and Design

After numerous visits to Cottonwood Park and coordination with the City of Lethbridge and Alberta Fish and Wildlife a site was chosen for the construction of an artificial hibernaculum (Photo 4, Appendix 4). The hibernaculum site was chosen based on the following criteria: security, slope aspect, suitable topography for sun basking, and nearby food sources. The hibernaculum was constructed during May of 2001 (Figure 3). Because terrain features made it difficult to use heavy equipment, all of the work was done by hand.

The Cottonwood Park hibernaculum contains two winter chambers, two birthing chambers, and a series of tunnels and burrows designed to provide suitable habitat for rattlesnakes. Thermometer probes were installed to monitor temperatures within the winter chambers. A perimeter fence about 40 m in length was installed around the hibernaculum to contain rattlesnakes. A 30-cm wide inward overhang was later installed around the top of the fence because of concern the rattlesnakes may be able to escape by climbing the fence. Escape seems somewhat unlikely because of many observations of unsuccessful attempts; however, two marked rattlesnakes were recaptured outside the perimeter fence. It is not known if they somehow managed to escape or were deliberately released prior to the security fence being installed.

Figure 3. Sketch of Cottonwood Park hibernaculum and associated facilities.

A chain link fence complete with locked gate was installed surrounding the enclosure in late summer following vandalism at the hibernaculum. At least one rattlesnake had been killed, and it is not known if others were killed or if some were released. Security concerns, as well as feeding and other project activities resulted in approximately 130 visits being made to the hibernaculum during the summer of 2001.

6.4.3 Relocation and Maintenance of Rattlesnakes

Eighteen captured rattlesnakes were relocated to the Cottonwood Park hibernaculum. An additional four rattlesnakes were released near the Popson Park hibernaculum (prior to construction and during the period of vandalism at Cottonwood Park hibernaculum) One of the snakes released at Popson Park returned to the Paradise Canyon golf course and was recaptured and released. All of the captured snakes were adults except for one baby caught in the Paradise Canyon subdivision. At least one rattlesnake released at the Cottonwood Park was a gravid female because a cluster of about ten neonates was observed on August 29 (Photo 3, Appendix 4).

Food and water were provided at regular intervals throughout the summer at the new hibernaculum. No live food was fed to rattlesnakes, only carcasses. During the early part of the summer, most of the food source was juvenile ground squirrels and trapped mice. Ground squirrels were available through trapping at a local golf course and collection of fresh road kills. Later in the summer, lab mice became available through the vivarium at the Agriculture Canada research station. Rattlesnakes were fed at 7-10 day intervals and were observed to readily consume the carcasses (Photo 5, Appendix 4). Rattlesnakes fed throughout the summer but refused food after mid-September.

On September 28, 2001, with the help of the Lethbridge Community College Wildlife Society, an intensive "sweep" was made through Cottonwood Park. The purpose of this was to search for and capture rattlesnakes that may have been released by vandals from the holding facilities prior to chain link fence construction at the new hibernaculum . One marked rattlesnake was located, captured and released back at the hibernaculum.

6.5 Habitat Improvements

Although no deliberate efforts were made to improve rattlesnake habitat, two fires – an accidental one in Popson Park during December of 2000 and the other (likely human caused) in Cottonwood Park during July of 2001 should improve ground squirrel habitat. Increased ground squirrel activity should provide increased foraging opportunities for rattlesnakes using the parks.

7.0 Summary

In 2000, the education process was initiated by developing and distributing a brochure, by holding an open house for public input, and by media articles designed to inform the public about the local population of rattlesnakes. Similar efforts were continued and expanded in 2001. A sharp increase in rattlesnake reports during 2001 and positive attitudes expressed during reports indicate that education efforts were successful. Recovery efforts will continue to focus on public education and cooperation to enlist and maintain support from the citizens of Lethbridge.

An artificial hibernaculum with related facilities was constructed in Cottonwood Park to provide a more secure habitat for relocated rattlesnakes (Photo 4, Appendix 4). Eighteen rattlesnakes were captured, released, and maintained at the Cottonwood Park hibernaculum. Rattlesnakes fed, mated, and gave birth at the Cottonwood Park hibernaculum. Over-winter survival of rattlesnakes will be monitored during the winter of 2001/2002. Rattlesnake movements and the return of rattlesnakes in the fall of 2002 will also be monitored.

Education efforts similar to those employed in 2001 will continue. A brochure station and signs have been installed in Cottonwood Park; additional interpretive signs are planned for 2002. Burning, grazing or mowing are methods, which may be used to maintain ground squirrel habitat.

Assuming the project is successful and Lethbridge has a sustainable rattlesnake population, at some point a decision must be made when active recovery efforts are no longer desirable or required. Perhaps a long-term average of 50 adult rattlesnakes in a Lethbridge population would be adequate. This may be a reasonable goal if populations surrounding Lethbridge are also maintained. At least another three years will be required to adequately determine recruitment and successful migration to and from the hibernaculum at Cottonwood Park.

8.0 Recommendations for 2002

- Continue with the education and coordination activities initiated in 2001.
- Continue to capture, mark, relocate, and maintain problem and "vulnerable" rattlesnakes. Install PIT (passive integrated transponder) tags to captured adult rattlesnakes.
- Capture and mark all rattlesnakes at the Cottonwood Park hibernaculum prior to release during the spring of 2002.
- Install external telemetry transmitters and PIT tags to adult rattlesnakes at the Cottonwood Park hibernaculum prior to release in the spring of 2002.
- Using radio telemetry and other methods, monitor rattlesnake movements and activities during the summer of 2002.
- Contain and feed neonate rattlesnakes at the Cottonwood Park hibernaculum prior to release in the spring of 2002.
- Provide fencing and traps at the east end of Cottonwood Park to intercept migrating rattlesnakes. Release (do not contain) any captured rattlesnakes near the Cottonwood Park hibernaculum.
- Provide fencing and traps near the Popson Park hibernaculum to intercept rattlesnakes migrating north towards Paradise Canyon. These rattlesnakes are considered problem or

"vulnerable" and would be moved to and maintained at the Cottonwood Park hibernaculum during 2002.

- Install interpretive signs in Popson and Cottonwood Parks.
- Install traps around the outside perimeter of the Cottonwood Park hibernaculum fence to capture returning rattlesnakes in the fall of 2002.
- During the fall of 2002, do a sweep of Cottonwood Park and surrounding area to search for and capture marked rattlesnakes for release back at the Cottonwood Park hibernaculum. For adult recapture, this should be facilitated by radio telemetry; however, the function and efficacy of attached transmitters is still unknown.

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10.0 Appendices

Appendix 1

Overview of present and future recovery actions (excerpted and revised from Ernst 2000)

Recovery Action 1. Provide public education regarding rattlesnakes.		**Responsibility**	**Timing**
Action 1.1	Distribute the "Rattlers, People and Parks" Brochure widely, but focus on residents in the vicinity of the snake populations.	Consultant	Widely distributed in 2001, Ongoing
	Make brochure available for pick-up at the nature center, library, Paradise Canyon, City of Lethbridge & University of Lethbridge.	Consultant	Ongoing
	Annual distribution of brochure to Paradise Canyon residents in conjunction with their newsletter. Consider wider distribution in other neighborhoods as required.	Paradise Canyon Community	Done in Fall 2000 and Spring 2001; will be done annually
	Make the brochure available at Popson and Cottonwood Parks.	City of Lethbridge	Annually April-October
Action 1.2	Issue public service announcement regarding rattlesnake safety and conservation.	Consultant	Done through media during spring of 2001
Action 1.3	Hold at least one interpretive program each year on snakes in the City.	Helen Schuler Coulee Center (HSCC)	Annually
Action 1.4	Have the City Parkland Ranger educate park users about rattlesnakes (discussion and brochure distribution)	City of Lethbridge	May-September
Action 1.5	Provide interpretive signs at Popson and Cottonwood Parks to provide information on rattlesnakes.	City of Lethbridge	2002
Action 1.6	Make rattlesnake information posters available at relevant events (e.g. Cactus Coulee Crawl 2001)	Consultant & Alberta Fish and Wildlife Division, Species at Risk Program	Ongoing
Recovery Action 2. Alter risky migration patterns by providing suitable and secure habitat in Cottonwood Park.		**Responsibility**	**Timing**
Action 2.1	Maintain ground squirrel colonies in Cottonwood Park	Consultants & City of Lethbridge	Annual
Action 2.2	Maintain ground squirrel habitat in Cottonwood Park (annual mowing or burning on selected sites).	City of Lethbridge	No action taken due to grass fire in summer 2001
Recovery Action 3. Reduce human/snake conflicts in the Paradise Canyon, Popson Park, and other areas.		**Responsibility**	**Timing**
Action 3.1	Provide trained people to relocate problem rattlesnakes. Training includes proper capture, marking, and release techniques.	Fish and Wildlife (Conservation officers)	Current & Ongoing
Action 3.2	Provide facilities for citizens to report problem snakes.	Fish and Wildlife, Consultant & HSCC	April-October
Action 3.3	Provide education (see Management Objective 1).		

Action 3.4	Provide fencing to restrict rattlesnakes from entering residential areas.	Alberta Fish and Wildlife Division, Species at Risk Program	April- October
Recovery Action 4. Provide secure hibernacula and foraging areas for rattlesnakes in Lethbridge.		**Responsibility**	**Timing**
Action 4.1	Establish a Wildlife Control Area around the hibernaculum in Cottonwood Park.	Alberta Fish and Wildlife	Applied for and rejected due to land being under jurisdiction of the City.
Action 4.2	Do not reveal specific locations of hibernacula unless there is a legitimate need to know.	City of Lethbridge	Ongoing
Action 4.3	Establish a hibernaculum in Cottonwood Park.	City of Lethbridge, Alberta Conservation Association, Alberta Fish and Wildlife Division, & Consultant	Completed May, 2001
	Fence area around hibernaculum to prevent snakes from escaping and to provide some security for resident snakes.	Consultant for Alberta Conservation Association and Alberta Fish and Wildlife Division,	Enclosure fence completed May 2001; chain link fence installed September 2001.
	Feed resident rattlesnakes	Consultant	Initiated May, 2001
	Install fencing and traps along north end of Cottonwood Park to capture snakes returning to Popson Park and relocate snakes to Cottonwood Park hibernaculum.	Consultant for Alberta Conservation Association and Alberta Fish and Wildlife Division	2002
	Install additional fencing around Cottonwood Park to prevent snakes from migrating onto road or into adjacent acreage development.	Consultant for Alberta Fish and Wildlife Division and Alberta Conservation Association	2002
Action 4.4	Restrict development in Cottonwood Parks that would negatively impact rattlesnakes or their habitat.	City of Lethbridge	Ongoing (protected as a nature reserve)
Action 4.5	Investigate the possibility of acquiring adjacent land for inclusion in Cottonwood Park.	Consultant & City of Lethbridge	Being investigated
Recovery Action 5. Reduce killing of rattlesnakes by humans.		**Responsibility**	**Timing**
Action 5.1	Provide education (see Management Objective 1)	Alberta Fish and Wildlife Division Consultant & City of Lethbridge	Ongoing
Action 5.2	Investigate the deliberate killing of rattlesnakes.	Fish and Wildlife	Ongoing
Action 5.3	Relocate snakes from other areas of Lethbridge to Cottonwood Park.	Fish and Wildlife, & Consultant	Ongoing

Action 5.4	Provide trained people to relocate problem rattlesnakes from residential areas and off of roads and adjacent areas.	Alberta Fish and Wildlife Division & Consultant	Snake handling workshop 2001
Recovery Action 6. Through research, improve understanding of rattlesnake movement, numbers, behavior, and population dynamics in Lethbridge.		**Responsibility**	**Timing**
Action 6.1	Continue to collect and record all snake reports from Fish and Wildlife, Paradise Canyon Golf and Country Club and the public.	Fish and Wildlife, Consultants & HSCC	Annually April-October
	Maintain snake database initiated by the City of Lethbridge Natural Resource Manager in 1998.	HSCC	Ongoing
Action 6.2	Search for additional hibernacula.	Consultant to Alberta Fish and Wildlife	Completed April and September, 2001
Action 6.3	Install traps around inside perimeter of Cottonwood Park hibernaculum fencing. Capture snakes ready to migrate, spray paint rattle section, install PIT tags, and install external transmitter to allow tracking.	Alberta Fish and Wildlife Division & Consultant	April/May, 2002
Action 6.4	Install traps around outside perimeter of Cottonwood Park hibernaculum and capture returning snakes for census information.	Alberta Fish and Wildlife Division & Consultant	August/ September 2002
Action 6.5	Mark captured snakes by spray painting rattle section. Marking would be used to increase knowledge of movement patterns and habitat use.	Alberta Fish and Wildlife Division	Ongoing
Recovery Action 7. Continue activities aimed at relocating the Popson Park rattlesnake population to secure habitat in Cottonwood Park		**Responsibility**	Timing
Action 7.1	Continue capturing and removing problem and vulnerable rattlesnakes to the Cottonwood Park hibernaculum.	Alberta Fish and Wildlife Division & Consultant	Ongoing
Action 7.2	Assuming the CP hibernaculum effort is successful: install fencing and traps around PP hibernaculum to capture returning snakes, spray paint rattle section and relocate to CP hibernaculum.	NRS/Consultant	August/ September 2003
Action 7.3	Continue education efforts, habitat maintenance, and working with other groups.	Alberta Fish and Wildlife Division & Consultant City of Lethbridge	Ongoing

Appendix 2
Summary of 2001 rattlesnake reports and removals.

Date	Location	Category	Action and Remarks
May 10, 2001	Paradise Canyon	Problem	Captured and removed to Cottonwood Park hibernaculum. Juvenile or young adult snake. Conservation officers removed snake because of proximity to residential area
May 17, 2001	Bickman Property	Vulnerable	Captured and removed to Cottonwood Park hibernaculum. Juvenile or young adult snake. Removed by consultant-considered vulnerable.
May 18,2001	Bickman Property	Vulnerable	Captured and removed to Cottonwood Park hibernaculum Adult snake. Removed by consultant-considered vulnerable.
May 21, 2001	Paradise Canyon	Problem	None. Conservation officer called out but snake escaped before CO arrived.
May 24, 2001	Fekete Property	Vulnerable	Picked up and removed to Cottonwood Park hibernaculum Juvenile or young adult. Removed by landowner-considered vulnerable.
May 25, 2001	Paradise Canyon	Problem	None-not found . Snake subsequently reported dead on May 31 (run over by vehicle) and rattles removed.
May 29, 2001	Fekete Property	Vulnerable	Young adult picked up and removed to Cottonwood Park hibernaculum. Removed by landowner-considered vulnerable .
May 31, 2001	Paradise Canyon	Problem	Adult snake captured and removed to Cottonwood Park hibernaculum. Removed by CO from within subdivision. Filmed by Discovery channel.
June 3, 2001	Popson Park (north end)	Routine	Reported in coulees near north end of park. No action taken-minimal risk factors.
June 3, 2001	Paradise Canyon #1 Canyon Gardens	Problem	None. Not reported until June 6. Residents just received contact information in newsletter on June 6.
June 9, 2001	Paradise Canyon Road	Killed	Resident phoned to report a rattlesnake killed on the Paradise Canyon road between the subdivision and golf course.
June 9, 2001	Paradise Canyon #56 Canyon Blvd	Problem	None. Not found.
June 9. 2001	Paradise Canyon road.	Vulnerable	None. Not found but resident phoned on June 10 to advise he had removed live rattlesnake off road.
June 11, 2001	Bickman Property	Vulnerable	Captured and removed to Cottonwood Park hibernaculum
June 15, 2001	Fekete Property	Vulnerable	Injured snake relocated to Cottonwood Park hibernaculum
June 17, 2001	Paradise Canyon	Problem	Relocated to Cottonwood Park hibernaculum
June 20, 2001	Cottonwood Park	Vulnerable	Captured and placed in Cottonwood Park enclosure
June 29, 2001	Fekete Property	Vulnerable	Relocated to Cottonwood Park hibernaculum

July 1, 2001	Paradise Canyon	Problem	Two snakes captured and relocated to Cottonwood Park hibernaculum
July 3, 2001	Paradise Canyon	Problem	Baby snake captured and relocated to Cottonwood Park hibernaculum
July 16, 2001	Paradise canyon Road	Vulnerable	Snake injured, removed to Popson Park hibernaculum (survival unknown)
July 18, 2001	Cottonwood Park	Vulnerable	Snake caught outside of enclosure fence at the Cottonwood park hibernaculum and put inside fence.
July 23, 2001	Paradise Canyon	Problem	Released at the Popson Park hibernaculum
July 30, 2001	Bridge Drive	killed	Two dead snakes; one on killed on road and one killed on golf course
August 6, 2001	Cottonwood Park hibernaculum	killed	Vandalism at the Cottonwood Park hibernaculum resulted in one or more snakes being killed within the enclosure.
August 11, 2001	Ryerson Road	killed	Lady phoned to advise she killed a rattlesnake in backyard even though she knew it was illegal
August 15,2001	Paradise Canyon	Problem	Two snakes released at the Cottonwood Park hibernaculum
August 19, 2001	Paradise Canyon	Problem	Snake released at Popson Park hibernaculum
September 12, 2001	Paradise Canyon	Problem	Released at Cottonwood Park hibernaculum
September 15, 2001	Paradise Canyon	killed	Resident advised he saw two dead snakes on Paradise Canyon road.
Summer 2001	Various locations	Vulnerable & Routine	Many reports received of rattlesnake activity in Popson Park, particularly on the dog run. Also, reports from Paradise Canyon area & the Mountain View sub.

Appendix 3

Observations at the Cottonwood Park hibernaculum during 2001.

- At any one time, the maximum number of snakes visible above ground level at the Cottonwood Park hibernaculum was roughly half the occupancy. Some snakes may aestivate (summer hibernation) during the hottest part of the summer.
- Rattlesnakes seemed to prefer smaller prey (i.e. mice) to ground squirrels.
- Most snakes do not become alert or defensive until approached within about two meters.
- Courtship (Photo 6, Appendix 4) and mating activity took place on several occasions and was first witnessed on July 22. It is not known if it was the same female involved in multiple mating or if there was more than one. Several snakes became very active about this time and began patrolling the fence. These may have been males trying to escape to find a mate.
- No competition was witnessed during courtship or mating activities.
- Sun basking is often done in part shade, perhaps to help provide optimum body temperature.
- Rattlesnakes were most active when temperatures were in the 15-20^0 C range. During hot weather they were only active in early morning and in the evening. The Cottonwood Park hibernaculum is in a sheltered bowl; therefore, micro-climatic features for sun basking are very favorable. During the fall of 2001, rattlesnake activity was high when daytime temperatures were as low as 10^0 C. On November 16, two adults and three neonates were observed outside the den and one neonate was observed at the entrance to the den on November 18, 2001 (temperature was 4^0 C and sunny).
- One or more females gave birth to ten or more neonates in the burrows provided for that purpose.
- Most skin shedding was done in the artificial burrows. Neonates shed their skins about a week or ten days after being born. The skins were discovered when the shallow burrow system was dug up to ensure there were no snakes remaining there during cold weather (three neonates were found and relocated to the main denning area)
- Neonates became active about ten days after birth and actively traveled around the enclosure throughout the fall. This is in contrast to the two clutches of neonates born at Popson Park during 2001, seen only on two occasions shortly after their birth (except for two single observations later in the fall).
- "Pinky" mice carcasses were provided and although actual ingestion was not witnessed, neonates were seen to drag the baby mice into the burrow. As well, grasshoppers were provided and again ingestion was not witnessed but the carcasses disappeared. Very little is known about the feeding habits of neonates but they may feed prior to hibernation if given the opportunity.
- Neonates are very defensive and seem to strike more readily than adults. Most adults will only strike when extremely provoked.
- Several adults actively patrolled the inside perimeter of the fence throughout the fall, presumably trying to escape to return to their hibernaculum.
- During the summer, rattlesnakes seemed to prefer the shallow burrow system constructed as a birthing area versus the tunnel system and winter chamber, likely because of thermal characteristics. Temperature inside the winter chamber varied from 14-17^0 C during the hottest part of the summer.

Appendix 4
Selected photographs of the Lethbridge rattlesnake population.

Photo 1. Ongoing development in the Paradise Canyon subdivision.

Photo 2. Paradise Canyon Road where snakes are run over each year.

Photo 3. Clutch of neonates (center of picture) born at the Cottonwood Park hibernaculum during August of 2001.

Photo 4. Cottonwood Park artificial den site.

Photo 5. Rattlesnake ingesting a lab mouse carcass.

Photo 6. Courtship activity at the Cottonwood Park hibernaculum.

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(as of February 2002)

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